IMPLEMENTATION OF IMPROVED HARVESTING METHODS TOWARDS PRODUCTIVITY AND SUSTAINABILITY OF DIPTEROCARP FORESTS UNDER SELECTIVE CUTTING SYSTEM

by:
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ABSTRAK

Hutan alam produksi di Indonesia didominasi oleh jenis-jenis dari famili *Dipterocarpaceae* dan dikelola dengan sistem tebang pilih. Dalam sistem tebang pilih tersebut hanya beberapa batang pohon dari jenis komersil yang dipungut, tetapi kegiatan pemungutan tersebut dapat mengakibatkan kerusakan yang besar baik pada tegakan tinggal maupun pada tanah hutan. Kegiatan pemungutan secara konvensional dengan memanfaatkan alat-alat berat sebagaimana diterapkan pada hutan alam produksi primer sejak dimulainya era pengusahaan hutan berskala besar pada umumnya tidak memadai, baik dalam hal efisiensi maupun dari segi konservasi lingkungan. Beberapa penelitian tentang kerusakan akibat penebangan secara konvensional di Indonesia menunjukkan bahwa kerusakan tegakan tinggal dapat mencapai 55% dengan kerusakan pada tanah hutan sebesar 20-30%.

Pengembangan metode pemungutan merupakan hal yang sangat penting dalam usaha untuk memelihara produktifitas dan kelestarian hutan *dipterocarp* serta mengurangi kerusakan terhadap lingkungan. Metode pemungutan baru yang dikenal dengan istilah *environmentally sound harvesting system, controlled logging, reduced impact logging, low-impact logging* dll. telah dikembangkan dalam beberapa tahun terakhir ini. Dengan penerapan metode baru tersebut dapat dimungkinkan untuk menekan kerusakan terhadap tegakan tinggal dan kerusakan pada tanah hutan. Beberapa penelitian tentang penerapan metode baru tersebut menunjukkan bahwa kerusakan tegakan tinggal dapat diminimalkan, menjadi 50% lebih rendah apabila dibandingkan dengan kerusakan pada metode konvensional. Kerusakan pada tanah hutan dapat ditekan menjadi tidak lebih dari 10%. Peningkatan biaya operasional pemungutan akan diimbangi dengan kondisi tegakan tinggal yang lebih baik, biaya pemeliharaan tegakan yang lebih rendah serta kondisi lingkungan yang lebih baik.

Kata kunci : sistem pemungutan kayu konvensional, sistem pemungutan kayu terpadu, kerusakan akibat logging, kelestarian, beaya pemungutan

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INTRODUCTION

The natural production forests in Indonesia consist of about 62 million hectares out of about 120 million hectares of the total forest, dominated by mixed dipterocarp forest. The forests are managed under selective cutting, *Tebang Pilih Indonesia* (Indonesian Selective Cutting/TPI) and *Tebang Pilih Tanam Indonesia* (Indonesian Selective Cutting and Planting System/*TPTI*). These silvicultural systems provide a good basis for the sustainability management of the forests.

The sustainable management of the forest can't be achieved only through the implementation of those silvicultural system alone. The efforts to sustain tropical forest must proceed simultaneously through two fronts: socio-economical, political front and the technological front (Dykstra and Heinrich, 1992).

From the technological point of view, timber harvesting as an important key in the forest management should be done efficiently with regard to the future productivity of the forest, environmental protection and conservation. Under selective cutting, harvesting is a part of silvicultural treatment and has a great influence to the composition, structure and growth of the residual stand. Conventional mechanized logging methods were used in virgin forests since the beginning of the large-scale concessions were very often inadequate, both in term of efficiency and environmental impact. Some study on harvesting damage in dipterocarps forests in Indonesia show, that conventional logging operation might damage up to 55% of the residual stand, and might disturb not less than 20-30% of the forest soils surface. The degraded residual stand may *lose* its ability to recover, regenerate and its productivity in the future. The productivity of the forest may be reduced also, due to the physical destruction (compaction) and erosion of the forest soil. According to Vanclay (1993) the careful harvesting operation is cheaper, more effective and more certain than rehabilitation.

Implementation of an improved harvesting system to replace the conventional mechanized logging is an urgent need in the framework of long-term general management objectives of the sustainable utilization of dipterocarp forests.

THE UTILIZATION OF DIPTEROCARP FOREST IN INDONESIA: A SHORT HISTORICAL BACKGROUND

Utilization of mixed dipterocarp forests for timber and non timber forest products for domestic use and export has a history as long as human civilization. The commercial utilization of the dipterocarp forest for timber began since midth of the nineteenth century. Departemen Kehutanan (1986) reported the forest utilization for construction and fuel wood in Riau archipelago in 1870, done manually by Chinese labour and called as *panglong*-system. The timber would be processed systems have been legally recommended since 1972 (*TPI*), the present logging operations were still following the easy selective logging. In practice, the silvicultural system and other regulations concerning forest utilization, based on the sustained and optimum yield principles were still very far from being properly implemented (Sudiono and Daryadi, 1978). After more than two decades of the natural forest utilization, there was a change in the global and regional situation and on harvesting costs, but the logging method did not follow those changes (Tinambunan, 1990).

CONVENTIONAL MECHANIZED LOGGING

The term of conventional mechanized selective logging refers to the extraction of the all merchantable trees without regard to the regeneration, structure, function and future productivity of the forest (Bruenig, 1996). The conventional mechanized logging operation could be characterized as below.

- Inadequate harvesting planning, in many cases absence of working plan.
- Inadequate control and supervision.
- Improper execution, try and error.
- High logging intensity : number of extracted trees more than 10 trees/ha. (can range up to 22-25 stems/ha, see Soekotjo, 1991; Dulsalam, 1993).
- Wood waste very high : on average 20-30% of the extracted timber (can reach up to 45%, Sumantri *et al.*, 1981).
- High damage to residual stand (up to 56%, see Table 1.).
- High forest soil disturbance (up to 40%, see Table 2.).

Table 1. Damage to residual stand after conventional mechanized selective logging

Province	Damage (%)		Source
	Basal area	Stem number	
North Sumatra	-	54,1	Abdulhadi *et al.*, 1987
Central Kalimantan	8,0 - 58,	-	Dewanto, 1996
	-	16,9 - 21,3	Purnama, 1996
East Kalimantan	-	30,0	Syachrani *et al.*, 1974
	-	36,4	Tinal and Panelewen, 1974
	-	40,7	Abdulhadi *et al.*, 1981
	-	6,7 - 40,1	Thaib, 1985
	28,6-29,9	-	Ruslim, 1994
	-	44,5-56,1	Bertault and Sist, 1995
	28,0-45,0	-	Elias, 1995

Table 2. Disturbed forest soil after conventional mechanized selective logging

Province	Disturbed area (%)	Source
West Kalimantan	6,2-18,4	Cannon *et al.*, 1994
South Kalimantan	9,1-14,7	Supriyatno, 1993
East Kalimantan	30,0	Abdulhadi *et al.*, 1981
	20,7	Ahrenholz, 1991
	13,2-14,5	Ruslim, 1994
	26,0-27,8 (36,6-41,5)*	Bertault and Sist, 1995
	9,0	Elias (in FAO, 1997)

(...)* inclusive disturbed area caused by felling

Certainly, commercial logging was commonly carried out, it could not be considered benign. Most of commercial logging in the moist tropical forest was not environmentally sound (Hamilton, 1991). Although selective logging was the least disturbing form of forest exploitation, still substantially alters the natural forest ecosystem. In practical terms, there was no commercial logging of tropical moist forest which proved to be sustainable from the stand point of the forest ecosystem (Botkin and Talbot, 1992).

IMPROVED HARVESTING SYSTEMS

Harvesting technology is a collective term that refers to the use of scientific and engineering principles in combination with education and training to improve the application of labour, equipment and operating methods in the harvesting of industrial timber (Dykstra and Heinrich, 1992).

The increasing rate of forest degradation caused by conventional logging in the tropical forest has led to growing concern to design a good harvesting practice. Research in this field, especially on the logging impacts in the tropic started since 1958 (see Nicholson, 1958) and followed by several studies in order to find a good logging practice for the natural tropical forest (Table 3 and 4). Improved harvesting techniques to reduce the environmental impact (known as environmentally sound harvesting system, controlled logging, reduced impact logging (RIL), low-impact logging etc.) was developed recently. Several harvesting guidelines concerning to reducing environmental impact, especially for harvesting operation in the tropical natural forest were issued (e.g. Weidelt and Banaag, 1982; Korsgaard, 1985;

Hamilton, 1987; Dykstra and Heinrich, 1992; Vanclay, 1993; Pinard *et al.*, 1995; Dykstra and Heinrich, 1996). Efficiency is the basic principle of the improved system. The term efficiency refers to low cost, low impact and low damage (Supriyatno, 1995).

In framework of Forest Management Certification, management planning and timber harvesting are two of the most important facets of forest management receiving attention during certification assessments. Low-impact logging designed based on the *best management practices* is as a starting point of the certification (Donovan, 1995). The essential characteristics of technical/operational implementation of this system are as follows

- A detailed pre-felling inventory: timber (harvestable timber, spatial distribution), regeneration, terrain condition inclusive topographic survey to provide a good base for the preparation of a better harvesting planning.
- A careful operation planning : determination of harvest intensity, planning the opening up (alignment of main road, secondary road, landing and skidding trails network), planning the felling sequences and felling direction.
- Careful execution : prescribed direction of felling and skidding inclusive winching
- Low extraction intensity: provide a better productivity for the next cutting and simultaneously to reduce the harvesting impact.
- Adequate technical supervision and control during the operation
- Logging restriction : e.g. skidding operation only during dry weather
- Post harvest treatment: immediately after logging (e.g. erosion prevention on skidding trails or log landings), damage assessment.

Moreover, education, training and motivation as well as a quality oriented payment scheme are also important to support the implementation of the improved harvesting system (e.g. Hamilton, 1987; Dykstra and Heinrich, 1992; Becker, 1995).

Results of the research on implementation of improved harvesting system to minimize environmental impacts associated with selective cutting in tropical forest in Indonesia and other tropical country showed up to 50% reduction of damage to residual stand compared with conventional logging. Disturbed area caused by skidding operation could be minimized until less than 10% (Table 3 and 4).

In the operational level, the choice of improved harvesting system depends on: utilization of wood (e.g. pulpwood- short wood system; sawntimber, poles and pulp wood- tree length or full tree system), regeneration or silvicultural system, opening up of the forests and mechanization level (Bol and Beekman, 1988). Moreover in the dipterocarp forests under selective cutting, the terrain condition, harvestable timber (dimension, distribution, stock), climate and financial feasibility are also important factors in the selection of harvesting system.

Table 3. Damage to residual stand after improved harvesting system

Country	Damage (%) Basal area	Damage (%) Stem number	Source	Remarks
Indonesia				
South Kalimantan	-	25,7	Sumitro, 1989	secondary logging, semi controlled
Central Kalimantan	6,9	8,7	Supriyanto and Becker, 1997	secondary logging, adapted RIL
East Kalimantan	13,1-16,9	-	Ruslim, 1994	first logging
	-	27,6	Bertault and Sist, 1995	first logging, RIL
	-	19,0	Elias (in FAO, 1997)	first logging, ril
Malaysia				
Sabah	-	15	Marsh *et al.*, 1996	first logging, RIL
	-	16,9-18,2	Appel, 1996	secondary logging, RIL
Suriname	-	20,1	Hendrison, 1990	secondary logging, controlled, only felling damage
	-	20,1	Jonkers, 1987	secondary logging, semi controlled

Table 4. Disturbed forest soil after improved harvesting system

Country	Disturbed area (%)	Source	Remarks
Indonesia			
South Kalimantan	11,7	Sumitro, 1989	secondary logging, semi controlled
Central Kalimantan	4,9-6,2	Supriyatno and Becker, 1997	secondary logging, adapted RIL
East Kalimantan	6,9-10,7	Ruslim, 1994	first logging,
	13,9 (28,4)*	Bertault and Sist, 1995	first logging, RIL
	5 (13)*	Elias (in FAO, 1997)	first logging, RIL
Malaysia			
Sabah	7,0	Marsh et al., 1996	first logging, RIL
	2,6-10,7	Appel, 1996	secondary logging, RIL
Suriname	5,4-7,3	Hendrison, 1990	secondary logging, controlled

(....)* : inclusive disturbed area caused by felling

HARVESTING COST

The costs of harvesting vary according to the natural characteristics of the stand (terrain, climate, standing stock), accessibility, labour cost, degree of mechanization, ecological and sociological considerations and convertibility of local currency (Dykstra,1991). Different harvesting techniques and harvesting intensity can result also in substantial variation on harvesting cost.

Several research show that the costs of implementation of improved harvesting in the dipterocarp forest are higher as for the conventional methods. Marsh *et al.* (1996) reported that the direct logging costs of reduced impact logging can be 10-15% higher as of a conventional method.

On another hand Marn *et al.* (in Korsgaard, 1985; in Bruenig, 1996) found in Sarawak that the operation costs in improved harvesting were lower than in the conventional method. Skidding costs and cost per cubic meter extracted timber in improved logging were in this case 25% and 26% lower compared with conventional logging. Chua (1986) concluded based on the results of field work on forest engineering improvement in Sarawak that the improvement can lead to a 18% reduction of skidding cost in comparison with conventional or traditional logging operation. Karsenty (1994) found also in East Kalimantan that skidding cost by RIL were lower than by conventional method.

Mussong *et al.* (1996) studied the economic appraisal of different logging intensities in the framework of a sustainable management of tropical rain forests in Fiji. The results show that at least two of three proposed harvesting intensities (high intensity: 50-60 m^3/ha and middle intensity: 30-40 m^3/ha were extracted) of controlled selective logging were neither causing increased exploitation costs, nor decreased benefits.

Theoretically, the direct harvesting costs in improved system in short term financial benefits are higher as in conventional system, due to an additional cost for better inventory, planning of opening up, better control and supervision, an additional payment for better job quality, treatment again erosion and may be due to lower timber production (lower logging intensity). In long term forest management view, the higher direct operation cost could be compensated by a better growth, reduction on stand improvement costs and a higher production in the next cutting and based on the residual stand conditions. The cutting cycle theoretically could even be reduced. Moreover a better environmental and aesthetically condition of the forest is an intangible benefit from the improved system.

CONCLUSION

The selective cutting system provides a good basis for the sustainable management of the dipterocarp forests. To obtain maximum productivity under this system, damage both to residual stand and forest soil caused by logging operation should be reduced to a minimum. It is possible to implement an improved harvesting system. Replacement of conventional logging by improved harvesting system can lead to several advantages, both in term of environmental and financial benefits especially in the long term forest management.

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